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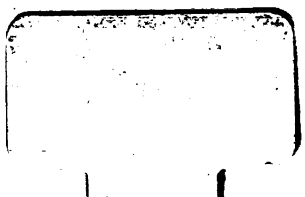

THE

NATIONAL IMPORTANCE

OF PRESERVING

MINING RECORDS.

Thomas
BY T. SOPWITH, F.G.S.,

MEMBER OF THE INSTITUTION OF CIVIL ENGINEERS,

AND OF THE GEOLOGICAL SOCIETY OF FRANCE.

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To Sir CHARLES LEMON, Bart., M.P., F.R.S.,

PRESIDENT OF THE ROYAL INSTITUTION, POLYTECHNIC SOCIETY, AND GEOLOGICAL SOCIETY OF CORNWALL,

&c., &c., & c.

I know of no one to whom the following pages can, with greater propriety, be inscribed than to you, who, residing in and representing one of the most important mineral districts of Great Britain, have ever evinced a desire to promote the best interests of mining, by encouraging and presiding over the scientific institutions of Cornwall, and by a steady devotion to the prosperity of the mining community of your neighbourhood. By few persons can the value of mineral statistics and of mining records be more ably appreciated than yourself, and in considering a national system of mining registration, your experience and influence will be of the greatest service. It is on these grounds that I avail myself of your permission to inscribe these observations to you, assured that this sanction on your part will, in no small degree, recommend the subject to the attention of the legislature and of the public.

T. S.

Newcastle-on-Tyne, August 20th, 1844.

PREFACE.

The following pages contain the substance of the opinions expressed on the subject of Mining Records, by some of the most eminent geologists and experienced miners, at various times during the last fifty years, with some further illustrations of their national importance, as involving, if neglected, the deterioration and eventual loss of a large portion of the mineral wealth of the country. Mining registration is not merely prospective in its benefits; it already forms, in many European states, the strong foundation of their increasing prosperity, whilst England stands alone in the total want of accurate statistics of its mines and mineral produce. The public is too largely interested in this question for it to remain much longer a matter of indifference, nor will English energy remain inactive, or the press withhold its powerful aid, to further any prudent measures that may be adopted by the legislature. The amendment of the mining system of Dean Forest, affords an example of what may be effected to remedy existing defects, and the education of miners in Austria, and the Mining Records of Belgium, are

noticed as examples which merit attentive consideration. The following resolutions of a meeting recently held in Newcastle, explain the objects contemplated by the bill recently introduced into parliament, and which it is hoped may lead to some salutary and efficient enactment to avert the loss of life, the destruction of property, and other ruinous consequences, which will inevitably result from the continued neglect of a National System of registering Mining Operations.

At a Meeting of gentlemen favourable to a National System for preserving Mining Records, held on Tuesday, the 16th July, 1844, at the Meeting Room of the Natural History Society, Newcastle upon Tyne, pursuant to public advertisement,

THOMAS SOPWITH, ESQ., IN THE CHAIR,

It was unanimously resolved,

On the motion of NICHOLAS WOOD, ESQ., seconded by GEORGE JOHNSON, ESQ.,

That this meeting is of opinion, that a general and uniform Registration of Mining Operations throughout the kingdom would tend to prevent many fatal accidents; would, in other respects, be of eminent utility to the interests of all persons concerned in mines; and would also confer a great national benefit.

And on the motion of WM. LAWS, ESQ., of Prudhoe Castle, seconded by WM. HUTTON, ESQ.,

That in furtherance of these objects, the draft of a bill on this subject, presented to this meeting by Wm. Bainbridge, Esq., barrister, be forwarded to the members for the borough, for the purpose, if possible, of being read a first time in the House of Commons during the present session of parliament, and being ordered to be printed, in order that the same may be generally circulated amongst the mining districts of the kingdom, for the opinion and consideration of those interested in mines.

WILLIAM BAINBRIDGE,

HON. SECRETARY, *pro tem.*

THE

NATIONAL IMPORTANCE OF PRESERVING MINING RECORDS.

THE following observations are offered with a view to direct public attention to the increasing necessity which exists for establishing a regular system of Mining Records throughout the kingdom. The subject is one which does not attract general observation and enquiry, because the sources of information are comparatively few, and the advantages of such records are usually considered as being very remote. The isolated attempts which have from time to time been made to effect an improved system of preserving Mining Records have entirely failed, and it is apparent that nothing short of legislative interference can succeed either in awakening attention generally to the subject, or in carrying it into execution. The attention which has recently been bestowed on many subjects connected with mining, and the greatly increased knowledge which now exists relative to the geological structure of our principal mineral districts, enable a large portion of the public to enter upon the consideration of this and similar topics, which formerly could only be approached by those immediately connected with mines. By those who have possessed practical opportunities of being acquainted with the value of Mining Records the subject has been long and earnestly advocated, as is evidenced in the following extracts from papers by eminent and experienced miners.

So long ago as 1797, Mr. William Thomas, of Newcastle, read a paper at a meeting of the Literary and Philosophical Society of that town, on the propriety of establishing an office, "for collecting and recording authentic information relative to the state of the collieries in the neighbourhood, and the progress that has been made towards ascertaining

the nature and constitution of the strata below those seams to which the workings in this country have been confined."

In this communication some of the general considerations bearing on the subject are so ably stated that it would be unjust to his memory to present them in any other but his own words. It is true, as afterwards stated by a committee of the society, after a lapse of nearly twenty years, that the proposal which he made, "though highly approved, and partially encouraged, fell to the ground." "*Until now*," they add, "it has never been revived." The loss of seventy-five lives in a colliery, near Newcastle, in 1815, arising from the want of Mining Records, for a time revived the attention of the society, and of the public residing in the district, but only to be again forgotten. Mr. Thomas's observations were again read on the 6th June, 1815, accompanied by a paper from the late Mr. William Chapman, Engineer, both which were published, with the following observations by the committee prefixed:

"In consideration of *the extreme importance of the subject*, and the *universal interest which it had excited*, it was resolved, that the society should publish these communications at its own expense.

"It would be painful and superfluous to dwell on the necessity which so loudly calls for exertion in the present circumstances of the coal mines in the district of the Tyne and Wear. It must force itself with irresistible conviction upon every humane and reflecting mind. Amongst various weighty reasons, however, that might be here enumerated, it will suffice to mention, that the more numerous and extensive the excavations become, the greater will be the difficulty of guarding against surrounding wastes, all of which must of course be filled either with water, carburetted hydrogen gas, or carbonic acid gas. It should likewise be held in remembrance, that when at a future period it shall be found necessary to work the lower seams in this coal field, the operations of the miner must be carried on under immense accumulations of water.

"The only merit for which the society presumes to arrogate to itself any credit on the present occasion, is for the purity of its intentions: An enlightened public, therefore, in candidly appreciating the motives by which it has been actuated, can hardly fail to refer them to the only source from which they either do or can proceed, namely, to an earnest desire to contribute to the comfort and security of

that most useful class of individuals employed in working the various mines in the united kingdom, by endeavouring, if it cannot wholly avert, at least to lessen the frequency of those calamitous accidents, to which the perilous nature of their occupation continually exposes them.

"In giving publicity, therefore, to measures which appear to be conducive to the attainment of objects of such acknowledged utility, the society feels that it is performing an appropriate and important duty. Its present aims, however, extend no farther than to the originating and bringing before the public the measures which are now suggested. It becomes it not to urge, neither has it the power, to enforce their adoption.—The completion of those plans, which it is the design of this publication to promote, must depend on the zealous co-operation of the community at large, and more particularly of the proprietors of mines, and those engaged in mining pursuits.

"It is with feelings of the liveliest satisfaction, that the committee take this opportunity of stating, that the proposals submitted for general consideration in the following pages, have undergone the inspection, and received the approbation of several gentlemen, conversant and interested in the subject of the coal mines."

EXTRACTS FROM THE PAPER BY WM. THOMAS, ESQ., IN 1797.

"Although to some it may appear that the plan about to be proposed has more of remote than immediate advantage in view, yet if it is acknowledged that such advantage will be the result, it is to be hoped the measure will not be deemed superfluous, nor considered as having for its object the gratification of an impertinent curiosity, rather than the general and permanent welfare of the public.

"As an institution, however, of the description now contemplated may, on a cursory view of the subject, awaken suspicion, by seeming to demand information on subjects of too delicate and secret a nature, intimately connected with individual property, it may not be improper, before we enter on its principles and details, to point out some of the more obvious and immediate advantages to be derived from it, as well as of some other circumstances which appear to be favourable to the undertaking.

"When the information, which it will be the business of such an office to collect, and to arrange, shall have been carried to some degree of maturity, by connecting the different

properties in the district, with the knowledge (as far as it has been obtained) of the nature of the strata which compose each respective division of that property, a regular history of the various seams of coal existing within each division, may be drawn from such information. By this means, a considerable expense in the article of *boring*, for the purpose of ascertaining the fact, will, in a great measure, be rendered unnecessary, the time employed in that tedious process will be very much abridged, and an effectual *winning* much sooner accomplished. Should suspicions of the efficacy of such information to the full extent, be urged against the plan, (and such objections may, perhaps, in some instances appear reasonable enough), yet they by no means destroy the great body of advantages which it is calculated to produce. A very partial boring, where previous information is obtained illustrative of the relative connection of the strata, has, in general, been deemed sufficient authority on which to form a decided opinion of the nature of the whole; and by those who are acquainted with the very great expense incurred in the prosecution of extensive borings, this cannot but be regarded as a very important consideration.

"Another considerable advantage to be obtained by this collective information and connection of property is, the knowledge that will be thereby procured with respect to the nature, situation, and direction of the various dikes and interruptions that have been met with, in prosecution of the workings of the respective seams within each individual property. By this information, neighbouring collieries, towards which the direction of those interruptions tends, may be extricated from a too fatal security, and led to make those preparations to meet approaching evils, the necessity of which could not otherwise have been foreseen, ignorant as they must have been that any disaster was likely to happen.

"Naturally growing out of this plan will be the history of the various seams within the neighbourhood, their relative connections, and their continuity through this district; points, which at present, strange as it may appear in a country so peculiarly adapted for discoveries of this nature, are very imperfectly known. This history, gathered from such authentic documents, presents many advantages. The proprietor becomes acquainted with the value and importance of his property; the resources of this country, in the invaluable article of coal, are reduced within the limits of calculation;

and the adventurer, who risks his fortune in those expensive and hazardous undertakings, the winning and working of coals, procures to himself a degree of confidence in the attempt, to animate his labours, and to strengthen the hope of a successful issue.

"But the further and more important consideration which so forcibly urges the adoption of the plan, to which the present hints are directed, appears to be that of transmitting to posterity such authentic information relative to the limits of every particular waste, and the full extent of the workings in the respective seams, as to preclude (except by great negligence or inattention) the possibility of any subsequent workings approaching the old wastes too abruptly; thereby placing the lives of a valuable description of men, as well as the property of individuals, in much greater security, and preventing those destructive and melancholy consequences which have but too frequently happened in this country, from the total want, in most instances, of such information.

"The precaution of previous boring may, by some, be said to provide all the requisites for preventing the evil complained of.—But independently of the expense to be incurred by such a process, it is impossible, in many seams of a tender quality, to pronounce on the sufficiency of a barrier to withstand the weight of water that may be lodged against it, in extensive wastes; or even to guard against the frequent negligence of the workmen employed in boring, to prove the extent of the barrier. Yet the present ignorant state of the country respecting this subject is such, and the limits of old wastes, from which the coal has been wrought prior to the period of traditional testimony, are so imperfectly known, that the remains of old pits, traced on the surface, are the only circumstances to enforce the use of those precautions on which rest so many important consequences. The frequent fallaciousness, however, of such appearances on the surface, and the fatal effects that have ensued from too great security in matters of this nature, are too well known to those interested in the working of collieries, to require more to be said in favour of a plan, which has for its object the collection of such information as will remove every doubt on so important a subject."

In the remainder of the paper, Mr. Thomas enters into details connected with the execution of such plans, but as they relate solely to the collieries near Newcastle, it is unnecessary to insert them here.

EXTRACTS FROM THE PAPER READ BY WILLIAM CHAPMAN, ESQ., C.E., TO THE LITERARY AND PHILOSOPHICAL SOCIETY OF NEWCASTLE UPON TYNE, IN 1815, ENTITLED, "OBSERVATIONS ON THE NECESSITY OF ADOPTING LEGISLATIVE MEASURES, TO DIMINISH THE PROBABILITY OF THE RECURRENCE OF FATAL ACCIDENTS IN COLLIERIES, AND TO PROLONG THE DURATION OF THE COAL MINES OF THE UNITED KINGDOMS.

"The philanthropic and beneficial plan, suggested by Mr. Thomas, of Denton, in the year 1797, relative to the obtaining of authentic records of the workings of coal mines, which is again brought before you, embraces not only the saving of much fruitless expense to future adventurers in collieries, but also the prevention of loss of lives from the casual and unexpected breaking into old wastes of coal seams, which frequently have been attended with disastrous results, either from the explosion of carburetted hydrogen gas, or from the sudden irruption of vast bodies of water. The plan, at the period it was brought forward by being read at a meeting of the Literary and Philosophical Society of Newcastle, was almost immediately submitted to the consideration of some gentlemen concerned in collieries, and in the managing department of them; but, from various causes, met with little encouragement, and was never carried into effect. A leading cause, probably, was, that as the *local knowledge* of the direction and rise or fall of the various dikes; the fluctuation of the height and quality of the seam of coal, with its bands, roof, &c.; and also the changes of direction of the dip of the seam, both horizontally and vertically, has only been acquired by the expenditure of large sums of money, in too many instances to little purpose, from the limited extent of the royalty, but yet at the same time capable of being turned to the advantage of the parties who have incurred these charges, as their reserved knowledge enable them to treat on safer bases with the proprietors of adjoining royalties than others not possessed of the facts they are acquainted with; consequently it could not reasonably be expected that such information should be made public: but whenever any given seam is wrought out or relinquished, the same argument does not hold to a sufficient extent; because, had the proprietors found it expedient to make their local knowledge subservient to their future interest, it would or ought to have been availed of prior to this period of relinquishment,—but even to this disclosure there are some exceptions, whilst the possessors

are working other seams from the same pits. I am, however, inclined to think that these objections are not of weight sufficient to balance the public good that may be derived from an authentic record of the circumstance recited; and, therefore, I perfectly accord with Mr. Thomas in that part of his fifth observation, where he says, 'that more particularly when a colliery gives up working any particular seam, there should be a public record of the exact limits of the waste at the moment the works cease; as on this depends, in a great measure, the security which subsequent workings will derive from such collected information.'—His sixth observation is equally necessary to be attended to, viz., that upon the plan of the workings of the seam, or in a written description, the position of fixed and permanent objects on the surface should be recorded.

"The next point of consideration is, how those records are to be obtained, and, *more essentially*, how to make them permanent; because the benefit to be derived from them is of far less importance to the present than to future times; therefore, I fear that nothing short of a public law can produce the end desired,—which, before I conclude, I shall attempt to prove is of sufficient national consequence to arrest the attention of the legislature.

" Nearly similar records are enacted for canals and other public works; therefore, as the records in question are in their results, of equal, if not greater national importance, I conceive there can be no difficulty in obtaining a public act, with clauses to the following effect, or such others as may be found eligible, on more mature consideration of the subject, by the proprietors of collieries, and those immediately concerned in their management, viz.—'That on the conclusion or relinquishment of the working of any seam of coals in any colliery, known by an individual designation, the owner or owners, workers, or occupiers of the said colliery, shall, within twelve months after such relinquishment, lodge, or cause to be lodged, in the office of the clerk of the peace of such county, riding, or division, as the said colliery shall be situated in, a duly authenticated and correct plan of the said wrought-out or relinquished seam of coals, drawn on a scale of not less than four chains to an inch, and containing the full extent of the workings of the said coals, *distinguishing such parts as are totally wrought out,* from *those where the pillars are left standing;* and also with the following particu-

lars delineated upon it, accompanied by proper explanations on the plan, *so far as there may be room for them;* and where not so, to have proper marks of reference, viz.

"'1st. The direction of all the dykes or fissures intersecting the seam.

"'2d. The position and denomination of all the pits.

"'3d. The precise boundaries of the colliery, so that the unwrought parts and extent of barrier may be known.

"'4th. Every drift into these unwrought parts to be correctly delineated, as to its direction and extent.

"'5th. That the direct line of dip, or depression of the seam of coals, be denoted by arrows pointing in the direction of such dip, and that such arrows be drawn wherever the direction of the dip varies, either in its horizontal course or angle of depression from the horizon; and that each arrow be accompanied by its quantum of declivity, or by its number or mark of reference.

"'6th. A delineation of all the roads and brooks, and the position of such permanent objects as are remarkable, viz.—churches, mills, bridges, considerable houses, &c., and finally, the line of the magnetic north, and the date of the year.'"

After noticing many details relating to the construction and preservation of the plans, Mr. Chapman adds—

"Under the authority of an act of parliament, containing clauses to the preceding effect, and such others as will naturally arise from a more complete discussion, future eras will obtain ready access to numerous facts essentially conducive to public utility. Had Mr. Thomas's views been warmly seconded in 1797, when he brought them forward, the public would now have been in possession of the plans and records of the following wrought-out or relinquished seams since that period on the River Tyne, exclusive of other parts, viz.—

NAME OF COLLIERY.	SEAM OF COAL.	REMARKS.
Walker.	High Main,	Wrought out.
St. Anthony's,	High Main,	Wrought-out.
	Low Main,	Relinquished.
Lawson's Main,	Low Main,	Relinquished.
Felling Colliery,	High Main,	Wrought-out.
Gateshead Park,	High Main,	Wrought-out.
Flatworth,	High Main,	Wrought-out.
Bigge's Main,	High Main,	Wrought-out.
Long Benton,	High Main,	Wrought-out.
Kenton,	High Main,	Relinquished.

"All these collieries are eastward of Newcastle, or shipped their coals below bridge, and extend under many square miles of surface. To the westward of Newcastle, Baker s Main, Throckley, and Heddon Hill, have ceased to work; some of their seams being wrought-out and others only relinquished.

"As the want of the plans and necessary records of these enumerated wrought-out and relinquished seams, and of others in different districts, would eventually be a serious loss, and there can be little doubt of correct plans of them existing, and even of seams wrought-out in periods considerably antecedent, I have consequently suggested a retrospective clause, which will tend to compensate for the measures recommended not having produced their intended effect at the time they were first suggested."

Several particulars are noticed by Mr. Chapman relative to the effect of such records, with reference to various collieries and seams of coal near Newcastle, with a view to show that, though accidents may occasionally happen where every due precaution has been observed, and that old plans, which are often inaccurately drawn, ought not to inspire too great confidence, yet that, even with partial inaccuracies, a knowledge of old plans might, in various ways, be serviceable, and he instances *a coal pit having been sunk, and other expensive operations upon a wrought-out seam of coals.* He observes, with great justice, that "Great Britain owes its pre-eminence in manufactures, and consequent power and population, in no inconsiderable degree to the abundance of its coal mines; and, therefore, it is an object of the first national importance to prolong, as far as possible, to future ages, that '*sine qua non*' of her population and power, by leaving to posterity certain records to direct them where they may obtain portions of coal, which in the time of the abundance of that mineral would not quit the cost of working; but which at the period, when it shall become scarce, would justify the *necessary expenditure of large sums*, such as no body of men might venture to lay out without the guidance of the proposed plans and records.—On the banks of the Tyne, considerably below Newcastle, this circumstance must be obvious, as the Low Main there lies mostly at the depth of 150 to 180 fathoms, and certain portions of it have been wrought-out and relinquished."

"The Rev. John Hodgson, whose humane exertions towards the prevention of accidents in coal mines, and the alleviation

of the evils arising from them, are well known, gave in the Newcastle Courant Newspaper (Sept. 24, and Oct. 1, 1814), a translation of a French pamphlet relative to the coal mines in the vicinity of Liege. From this interesting narrative, it appears that 91 men and boys were inclosed in a coal mine by an irruption of water, similar to what lately took place at Heaton; and that although 70 of them were saved by a communication from an adjoining mine then in working, the event was rendered both tedious and uncertain, because 'no exact plan of the workings was to be found.' The writers of the report on that accident, make also the following observation, viz. 'We cannot but allow that our knowledge of the old workings is very imperfect, and that the utmost exertions of science became necessary, and have for many years been exerted to overcome the physical difficulties which wastes filled with water and foul-air present to us on every side.'

"The mines in the vicinity of Liege were extensively wrought when the coal mines of this kingdom were in their infancy; and so early as the fore part of the 15th century, if not sooner, the conducting of coal mines was there under legislative regulations, and *subjected to visitation and controul* in their workings.

"It is at present premature to enter into particulars, because all I want to shew is, that the experience of coal miners on the continent proved, several centuries past, that the public welfare *required* and *demanded* a correct knowledge of the progress and manner *in which individuals conducted their collieries.* Therefore, as similar circumstances in these kingdoms *are not less urgent*, it is expedient that the subject of these essays should rouse the public attention, particularly as increased ills, *in a rapid progression, are attendant on delay.*

"At no very distant period, and probably in this century, the greatest bar to access to the coal seams that *lie at a great depth*, will arise from the drowned wastes of the upper seams. Correct plans, showing the barriers of whole coal, and any incidental patches, left from the acute intersection of dykes, or other causes, will shew, wherever a sufficient mass of whole coal affords a safe passage to the lower seams. It is the general custom in coal leases to compel the lessee to leave a surrounding barrier of whole coal of from 20 to 40 yards in width, (according to the depth the seam lies at, and other operative circumstances), without consent of the lessor to do

otherwise, from which, when the seam is nearly exhausted, liberty is generally obtained to work away the barrier on the *dip side of the colliery*, and frequently elsewhere. The upper side, through prudential motives of self-interest, is generally undisturbed : thus, for the most part, a width of whole coal will be left sufficient to pass through to the lower seams.

" Whatever gives the certain means of going down to the lower seams in future periods, must add eventually to the value of coal royalties, whether they remain with the present possessors, or go to their heirs and assigns, and more particularly will enhance the value of the property lying to the rise of the barrier, viz., that of the heirs or assigns of those persons who now generally take away that barrier: from this circumstance it will not only be equitable to the public, but advantageous to the parties themselves on whom the restrictions will fall, if the legislature restrain the working any barrier, without leaving, at determinate intervals, more or less distant, according to the number of workable seams below it, a certain width of unbroken coal adjoining to the whole coal, or barrier, of the adjacent royalty, and in length double that width, so as to leave between the two a square of whole coal, equal in length of side to the breadth of the combined barriers. This will afford ample means to pass down separately and independently to all the workable seams, there being left in each successive seam, correspondent pieces of whole coal perpendicularly under those above; but extending wider, to allow for incorrectness of measurement and greater super-incumbent weight.

" Also, as some royalties are too extensive to be advantageously wrought from one point, it might be enacted, that where the extent between barrier and barrier exceeds some given distance, suitable intermediate columns of whole coal should be left untouched, to answer the purposes already described.

" As there is generally a square of whole coal left at the foot of each pit, with certain passages through it, frame dams of timber might be placed in them on the relinquishment of the pit, or even other more perfect means used: the former might answer the end for a considerable period, but we find the writers of the French pamphlet already quoted, complain of them, as they say, ' It is true that much of the mischief by which so many miners, for some years past, have fallen victims, must be attributed in part to the frame work and

wooden dams, which in old times have been made to keep back the water, and to prevent communications between one working and another.'

"An old Flemish law, to encourage adventurers to carry forward levels of drainage in suitable countries is worthy of adoption: it gives to the adventurer one eightieth part of all the mineral raised from mines thus laid dry, with certain exceptions, which exemptions have been found injurious, and consequently not advisable to be followed.

"I have already observed that Great Britain, in a very high degree, enjoys her pre-eminence in manufactures, and her consequent vast population, and the *increased value of her landed property* to the abundance of her coal mines. It therefore follows, that whenever they are materially exhausted, as they at no very distant period will be, *without some change of system*, she will progressively descend from her pre-eminent state, and become only a secondary power."

The celebrated WERNER, in his Treatise on Mineral Veins, expresses his opinion of the value of Mining Records in the following emphatic terms:—

"Such a collection, the plan and description of the district, form together a complete and instructive whole. If our ancestors had left us such documents for two centuries past, or even for half a century, what advantage would it not have been to us? From what doubts would it not relieve us? With what anxiety do we not turn over the leaves of ancient chronicles in search of information, often very imperfect, obscure, and uncertain? With what pleasure do we not receive the least sketch or plan of some ancient mine? With what pains do we not rake up the old heaps of rubbish brought out of old excavations, to discover pieces which may afford us some idea of the substances which were formerly worked out? Yet, between these documents, and those which we might obtain in the way pointed out in the preceding paragraphs, there is as much difference as between night and day. Is it not an obligation, a duty, for us to collect and leave to future generations as much instruction and knowledge as possible on the labours carried on in our mines, whether it be in those that are still worked, or in those which have been given up?"

Such was the opinion of this eminent geologist, whose knowledge of practical mining adds great weight to the recommendation. He notices the historical interest and scientific instruction afforded by such records, and not only

in these respects, but as regards the actual profit and loss of mining adventure, his well-merited encomiums are borne out by the testimony of the most experienced geologists and miners. The publication of Werner's directions for constructing plans, and preserving geognostic descriptions of mineral districts, together with other similar works, diffused much useful information on the subject, and led to a more general adoption of plans in conducting subterranean works; but the progress of improvement in this department of science has been slow, and Werner's recommendation far from being universally, or even generally, attended to.

The utility of recording subterranean operations has been much undervalued by persons unacquainted with mining details, as well as by many of the less-informed class of mining adventurers, who are with difficulty brought to perceive the advantages, or to adopt the practice, of any system to which they have been unaccustomed: hence the plans of mines in this country are generally confined to such particulars only as are indispensable for conducting the subterranean works, without any reference to the past history and future prospects of the mine, or any sufficient record of the strata and various geological features. The accumulation of such a mass of practical information would in time prove of incalculable benefit, and eventually obtain that consideration to which it is so much entitled.

So long as an indifference to the general advancement of geology, in connection with mining, prevails, it is in vain to expect that any material improvement can be effected in planning subterranean works; but the progress of science, and the efforts of intelligent practical miners, seem likely to open out a wide field of observation and enquiry, and to pave the way for a more general and scientific system of recording the progress of mineral works in the great coal and lead-mining districts of the United Kingdom.

In a work which I published in 1834, on the suggestion of my late highly-valued friend, John Buddle, Esq., I offered several practical suggestions, relative to the construction of geological and mining plans, accompanied with notices of some of those considerations which render plans and sections so important in the economy of mining, and adverted to the increasing necessity which exists for a more rigid attention being paid to such documents, than has hitherto been commonly bestowed upon them. Subsequent experience has added many strong confirmations of the views then express-

ed, and which at that time received the entire concurrence of the experienced miner, to whom the work was inscribed.*

Subterranean wealth differs from other property chiefly in the extreme uncertainty of its existence, and the difficulty of its discovery. The valuable mining manor of Alston Moor was, upwards of 200 years ago, considered to be nearly exhausted of its mineral treasures, though it abounded in those hidden and almost boundless stores, which have since been so fruitful a source of employment and opulence. A few scanty hints relative to the history of mining in Alston Moor extend to a period of nearly six hundred years ago; but, excepting some information on the royal charters and privileges granted to the miners, no records remain to perpetuate the works connected with it. The situation and extent of the various mines which have, from century to century, been prosecuted, might have been clearly delineated and preserved at an expense exceedingly small in comparison with the expenditure of mining, and would have proved of incalculable value in promoting the interests of mining and the advancement of geological science. Not only ought such records to consist of mere plans and sections, but should be accompanied with explanations of the reasons why they were forsaken, in what state the several workings were left, and whether there remained in them any inducements for the expenditure of capital in further adventures. Of late years, the subject has received a considerable share of attention; but much remains to be done before any permanent and scientific record of mining operations can be generally adopted, on a scale commensurate with the importance and utility of the undertaking.

Among other causes which have retarded the progress of improvement in mineral plans and sections, as well as other regular details of subterranean operations, the speculative and uncertain nature of mining is one of the principal. Lead mining, in particular, has been viewed so much as a mere lottery, as to induce a neglect of those regular accounts

* The following is a copy of the dedication of the work alluded to:—"To John Buddle, of Wallsend, Esq., Member of the Institution of Civil Engineers, whose professional eminence, and scientific acquirements, as a Colliery Viewer and Engineer, have been long and deservedly appreciated; and whose private worth, extensive information, and social qualities, are still more highly valued; the following treatise, written expressly at his suggestion, and favoured with his revision in its progress through the press, is inscribed, with most sincere esteem and regard."

and other records which are found so indispensable in other transactions. But mining, though certainly speculative, is not entirely the work of chance: in it, as in all other business, he who classifies his accounts, and can at any time readily ascertain the exact sources of expenditure and income, who derives experience from the constant accumulation of facts, and can comprehend the whole extent and object of subterranean works, possesses very superior advantages over those who have no such data. The well-founded calculations of the one are, in the ordinary course of affairs, much more likely to be attended with success than the vague and unsatisfactory speculations of the other, who, (and experience daily testifies the fact) are often involved in difficulties that might have been easily avoided, and in expenses which need never to have been incurred.

A reliance on *chance*, instead of science, as the presiding genius of mining adventure, must, sooner or later, affect its own existence, by demonstrating that the singular instances of good fortune which sometimes occur, bear a very small proportion to the numerous undertakings which, begun and continued without any means of appreciating the employment of capital, and the condition of the works, end in disappointment, and create a highly-injurious prejudice against mining speculations. This prevailing idea of the uncertainty of mining adventures, and a consequent disregard of method in conducting them, are especially detrimental to the interests of such districts as mainly depend on private adventure for the discovery of the mineral treasures they contain. The *prospects* of mining cannot, indeed, be reduced to certainty, but it is exceedingly desirable *that all the details of conducting it* should be so. An intelligent system of this kind would attach to it a character of skill and method, for want of which it is much undervalued as a means of employing capital, and an opening has been thus afforded to impositions which have greatly lessened the public confidence in such undertakings. Whatever tends to increase a knowledge of mining undoubtedly contributes to its permanent interests; and if the present depression of the markets continue, if prices will not rise to meet the present and increasing expenditure of mines, there is the greater necessity for the adoption of every means to promote future economy, and to prevent future waste.

A residence of some years in the lead mining districts, with considerable practice in mineral surveying and plan-

ning, and repeated conversations with many intelligent proprietors and agents of mines, led me, many years ago, to form those opinions of the value of, and increasing necessity for, accurate mining records; and they have been further and strongly confirmed by subsequent observation, and by the judgment of those who, by a practical knowledge, added to long experience of mining, are best able to form a correct opinion on the subject.

Since the production of the first geological maps, by the Board of Agriculture, in 1794, the progress of geology, as a science, has advanced such maps to a considerable degree of perfection. The transactions of various societies, and the publication of numerous plans and sections, have furnished many admirable examples of the interesting and beautiful manner in which the complicated details of geological structure can be rendered intelligible. This excellence, however, has not yet extended to mining plans, at least to any considerable extent. Most of these consist merely of outlines of the course of the principal workings, without any delineation of the several strata, or of the relative productiveness of the works of different periods. Vertical sections, which are of great utility, are far from being general; and I know of one establishment only in which a regular series of them is preserved. A great source of imperfection in such plans is, the want of an uniform and practical mode of reducing the inequalities of hilly ground to a plain surface. Rules for doing this are learned by almost every school-boy, but either a difference in the practical method of ascertaining and representing these inequalities, or a total disregard of them, is the frequent source of very material errors.

Among other causes which contribute to the imperfect state of mining plans, may be mentioned the want of a popular treatise on the subject, which should familiarly explain the mode of using the different surveying and drawing instruments, illustrate the principles of representing horizontal, vertical, and inclined planes, and point out the best way of taking the measurements required for each. Examples should be given of the best methods of representing the different parts of mines, and an attempt be made to fix on general characters for that purpose. For want of such information, many miners, who can dial with accuracy, are at a loss how to represent on paper what they have measured; and some fruitlessly attempt to lay down and connect horizontal and vertical objects on one orthographic plane.

What on one plan represents an adit, on another represents a vein or dyke; and such plans, therefore, for want of uniform modes of representing similar objects, can never be of any general or permanent utility. That these and many other imperfections exist to a considerable extent, is well known to those conversant with the subject, and they are here alluded to as forming some apology for an attempt to propose any amendments.

For the preservation of records of subterranean works, a strictly accurate plan of the district in which they are situated is essential. Owing to several causes, plans of mountainous counties have not in general been constructed with that extreme regard to accuracy, without which any inference as regards either geology or mining must be fallacious. The want of system in reducing hills to a plain surface, the uncertain weather and boisterous climate of such districts, so unfavourable to the use of good instruments, and the neglect of a very strict and indispensable regard to the variation of the magnetic needle, have all tended to occasion a great want of accuracy in plans of mines and of mineral districts.

The value of lead and copper ores, and the cost of their production, are so variable, that veins which at one time will not pay the expense of working, will at another amply recompense the adventurer; and hence the greater necessity for preserving a faithful record of the condition and relative value of every vein.

JOHN TAYLOR, Esq., of London, in a report concerning an extensive lead mine district, belonging to Greenwich Hospital, which is placed under his superintendence, observes as follows:—

"One thing I think of great importance, which is, that PERFECT RECORDS of what has been done in the pursuit of every vein on the estate should be preserved; and I would recommend, for this purpose, that in all future leases a clause should be introduced, to require the adventurers to keep SECTIONS and PLANS of all their workings; and that the officers of the hospital should have power to inspect and copy them at all times; and it would follow, of course, that the moor master, or some competent person, should delineate these on a general plan, and preserve a collection of the sections of each mine."

As regards Coal Mines, the following remarks, by the late JOHN BUDDLE, Esq., are equally conclusive as

to the necessity which exists for improved methods of preserving subterranean records :—

"It is obvious that many collieries which are now open will sooner or later be shut up, and lie dormant for various and indefinite periods—and the probability is, that in many cases all knowledge of the dykes which intersect them may be lost, and that the parties having to re-open them may be as ignorant, or even more so, than those who first opened these mines.

"It is not necessary that I should dwell on the extent of the loss of property and of lives which may result from such a state of things. My object is to draw the attention of the society,* and of the public to the means of avoiding it.

"Although the several dykes which have been met with in all the working collieries of the present day, are accurately represented on the working plans of these collieries, yet, from the detached and local nature of those plans, no general and accurate notion of their lines of direction, bendings, and throws, can be formed from such detached sources of information. Nothing can effect the object of gaining an accurate knowledge of this important feature in the geological structure of our district, but the construction of a map of it, laid down from actual survey, on which all the dykes that have been yet discovered shall be correctly represented. This map to be accompanied by a book of sections, showing the throws of the dykes in every part of the district. The promotion of such an undertaking is worthy of the most serious and prompt consideration of the society, as well as of the patronage of the landed and mining proprietors of the country."

It would be easy to multiply testimonies of this kind, but the general facts of the present imperfect state of mining plans and records, and the great utility of their being improved, are generally admitted. It is equally certain, that notwithstanding the frequent and earnest appeals of the very highest practical, as well as scientific, authorities, little has been done towards effecting any material amendment in this department of science.

The first and most obvious step towards improvement in mining records is, to collect and arrange, with a view to

* Natural History Society of Northumberland, Durham, and Newcastle upon Tyne, at which society the paper from whence this extract is made, was read December 20th, 1830, and has since been published in Volume I. of the Transactions.

their permanent preservation, all existing plans and details of subterranean works. Many plans of mines are sufficiently intelligible to those who have constructed, or are familiar with them, but different modes of representing similar objects, vague and indefinite descriptions, or a total absence of writing or lettering, the want of connection with the true meridian or other permanent objects, and other similar imperfections, render such plans much less valuable and important as records, than they would be, if constructed with a rigid and undeviating regard to these particulars. It would be well if *uniformity of scale and conventional signs*, could be generally adopted for plans and sections. Such uniformity would be a most important point gained, towards obtaining that "knowledge of our subterranean wealth," which an eminent authority has justly observed, "would be the means of furnishing greater opulence to the country, than the acquisition of the mines of Mexico and Peru."

The *conventional signs* employed in Mining Plans vary in different parts of the kingdom, owing to different strata, modes of working, &c.; but it is well worthy of the attention of land and mine owners, to effect *uniformity in their plans and sections*, the value of which, as an index to, and record of, mineral property, would be exceedingly great. The owners and all other persons interested in such property, would thus be able to gain a clear understanding of the plans of them. Engineers or viewers from other parts, could readily form an exact idea of the nature and extent of the several workings; each new manager would at once become acquainted with what had formerly been done, while successive generations would profit by invaluable stores of information, and would thus transmit, from age to age, legible records of a subterranean world of wealth.

Plans of mines are, in some districts, carefully constructed from time to time in the offices of the several collieries or other mines. That the importance of preserving these should not only be admitted, but strongly urged, by the very best authorities, and that no regular system of doing so has hitherto obtained, are matters which it is difficult to reconcile. Plans after plans have been lost or destroyed, which, if now in existence, would be of infinite value, and which might have been preserved at an expense infinitely short of any thing like commensurate with the value of possessing such data concerning the mineral wealth of a district. An intelligent mining director has informed me, that for plans

and sections of the old workings in a district under his management, he would willingly have given ten thousand pounds; and such, from the causes already mentioned, must ever be the result of neglecting this important department of practical mining.

An indifference to what is no less matter of private and commercial interest than of public duty, is probably destined not to continue in an age when the minutest branches of science and natural history are deemed worthy of arduous and persevering pursuit, of costly publications, and of promotion by public societies and subscriptions. Geology, as a science, has made rapid advances in public favour, but those minute practical details, from which alone any important benefit or solid information can be derived, are considered by many as devoid of interest, and useful only in the private office of mining agents. Geology and mineralogy, form a wide field of investigation and enquiry, and collections of accurate plans, sections, and drawings are the surest guides to the study of them; they are the alphabet by which the hidden and mysterious structure of the earth is unfolded to our view, and if properly arranged and preserved will in time form a language not only intelligible and interesting as a subject of general information, but also as important auxiliaries to practical mining.

The subject of Mining Records has an additional claim on attention by its connection with local and national prosperity, as well as with interests which are dear to every breast, the interests of humanity.

The practicability and economy of preserving plans of mines may be elucidated by examples, which I carried into effect as illustrations of the subject.

In November 1828, I made a careful subterranean survey of a mine, situated in the forest of Lune, in Upper Teesdale, 20 miles from my residence. I projected the plan on a scale of one chain to an inch, made a ground plan of the veins and levels, with the washing floors, &c., and also a section of the several strata and workings. These I etched on copper-plate, and, after colouring the impressions, forwarded them to the agent. The intention was, at intervals of one or two years, to add the new workings on the copper-plate, to colour those *new parts* only, leaving all the former workings in out-line uncoloured, and hence, if continued every two years, say for ten years, each partner would have six plans, as follows:—

No. 1. Plan showing all the workings of the mine up to November, 1828	£0	10	6
— 2. Plan of the whole mine, the coloured portion showing the several levels and other workings made from November, 1828, to November, 1830	0	5	0
— 3. Do. do., from Nov., 1830, to Nov., 1832	0	5	0
— 4. Do. do., from Nov., 1832, to Nov., 1834	0	5	0
— 5. Do. do., from Nov., 1834, to Nov., 1836	0	5	0
— 6. Do. do., from Nov., 1836, to Nov., 1838	0	5	0
	£1	15	6

This collection would preserve a record of the entire operations of the mine for 10 years in the hands of each partner, for an annual expense of 3s. 6d.; and for clearness, accuracy, and cheapness, such a mineral record has not, I dare safely venture to affirm, been carried into execution in this, or, perhaps, any other mining country.

In this instance, the partners were fewer in number than in many lead mines, and the mine difficult of access. Every possible economy was used, and though nine guineas for the original survey, and four or five pounds for subsequent surveys, could scarcely pay in one single example, where travelling expenses, carriage of instruments, &c., were as expensive as if several contiguous mines were to be surveyed, yet it is quite sufficient to show, that the adoption of mineral plans, even on the most perfect scale, when once begun and persevered in, forms a very inconsiderable item of expense in mining. The present instance of supplying every partner with a plan being less than $\frac{1}{6}$ *per cent.* on the annual expenditure.

Another example was Holyfield mine, which I engraved in like manner on a plate 24 in. by 12 on similar terms—

28 Partners.—Each an original plan, at 10s. 6d.,	£14	14	0
Do. For surveys and plans every two years at 5s., 28 partners, £1 5s.	35	0	0
	£49	14	0

Being to each partner an annual cost of 3s. 6d. per annum for the entire series.

If the mines of a district were regularly surveyed in this manner, not only the partners of the mine, but the lord of

the manor, would be interested in preserving them, and such engraved sections would also be invaluable illustrations for geological lectures, and for the instruction of young miners. Geological societies, in different parts of the kingdom, would also probably pay a moderate sum for such a series of plans,* all which would contribute to the exactness and economy of a system of preserving mining plans and sections, and accomplish in the most perfect and scientific manner, a record of subterranean works, at once a useful guide to the present, and an invaluable legacy to future generations.

The unqualified approval of this mode of preserving lead mining plans, by several eminent practical and scientific geologists and miners, was gratifying to me; but domestic circumstances soon after called me from the district, and professional engagements prevented me from following up the endeavours which I had made to effect an improved practice in this department of surveying in the lead mining districts. I am not without hopes that these endeavours may have been useful by calling attention to the subject; for though the above and similar instances barely repaid my actual expenses, they met with none of that opposition which improvements, however desirable, are often destined to encounter. On the contrary, from agents and many other gentlemen connected with mining, my enquiries and suggestions met with friendly encouragement, which I shall ever gratefully remember, united as that remembrance is, in most instances, with feelings of sincere regard and esteem.

About the same period (1828) I published some observations on the subject of preserving mining records; the following extracts from which briefly explain the objects I had in view, and the mode of representation which I proposed to adopt.

"These plans exhibit the subterraneous workings of the mines, by a HORIZONTAL OR GROUND PLAN, and by an UPRIGHT OR VERTICAL SECTION; the former exhibits the course and bearing of the veins leased by each company, and the levels, cross-cuts, drifts, &c., by which access is had

* The district in which one of these mines is situated is highly interesting to the geologist from its abounding with the stratified range of Basaltic rock, which forms so prominent a feature in the scenery of Upper Teesdale, and immediately above which, on the summit of Cronkley Scars, the operations of the mine were carrying forward at the time of this survey.

to the veins for procuring lead ore. The section shows the order of superposition, and thickness of the various strata as they occur in different mining fields, with the extent of the workings in them, up to the date inscribed on each plan. It is proposed to add the subsequent operations at future periods upon the same copper-plate, or, if necessary, on another plate, the impressions of which will be attached to, and form a continuation of, the former. The subsequent plans will have only those parts coloured, which have been worked since the preceding date, and thus form a regular series of plans, exhibiting in a clear and striking manner, a record of mining operations, which can be furnished to every partner at the cost of a few shillings for every 30th or 32nd share yearly, or so often as, from the extent of new workings, may be desirable. As these future plans will not, in general, exceed half the cost of the original one, it is suggested that such a regular record of all the workings of mines, placed in the hands of every partner at so trifling an expense, would tend to increase their interest in, and knowledge of, mining affairs, facilitate their correspondence, and render clear and intelligible many subjects which, especially by distant partners, are often imperfectly understood.

"Those who are acquainted with the practical details of mining are well aware, not only of the utility and convenience of having proper plans of the workings, but also of the great disadvantages and needless expense often incurred by the want of them. The engraved plans now offered to the mining proprietors of Alston Moor, and to those interested in the study of geology, continued in the manner above stated, would obviate these difficulties, and, at the same time, furnish to men of science a valuable fund of materials, derived from authentic sources, and possessing both minuteness of detail and accuracy of delineation."*

"Geological plans and sections of mines have, from a variety of causes, been much less generally attended to, than their importance and utility demand. Not only do they afford very material assistance in the actual prosecution of the works, but are further valuable from the minute and accurate geological information necessarily blended with them. By supplying numerous records of established facts, in the disposition and changes of strata, the position of veins, and their productiveness under various circumstances, they

* Reference to Plans of Mines in the manor of Alston Moor.

become admirable data for the study of a science, in which a knowledge of facts, and a patient investigation of practical results, are the only sources from which any important discoveries can be derived."

"In the lead mining districts, the utility of such records is increased by the non-residence of a large portion of the shareholders of mines, who, without the assistance of plans, and regular details, can only form very imperfect ideas of the nature and objects of the different works in progress. These, in general, have had little or no opportunity of becoming conversant with such details, and are, therefore, naturally indifferent to the advantages which may be derived from them. To many of these, it is anticipated, the plans now published will prove very acceptable, by affording both a general idea of the nature of mining, and of the manner in which its operations are rendered intelligible, by means of plans and sections. And though such shareholders must necessarily place great reliance on the skill and integrity of their resident agents, and cannot, from occasional opportunities, acquire the knowledge of mining affairs requisite to the immediate direction of them; yet, in conducting such expensive speculations as mining, it is highly-desirable that the operations should be, as far as possible, made intelligible to all who take any interest in them. Such a general knowledge as would enable them to understand the nature of the works, and the objects contemplated in any suggested undertaking, would be much more satisfactory than the entire dependence on others, induced by the want of means to form an opinion for themselves.

"The object of these plans is to furnish a clear and intelligible representation of the works being carried forward at the respective mines, and of the various strata in which they are situated. By such plans of mines, accompanied with the correspondence of an agent or resident shareholder, the other proprietors, however distant, may at once perceive in what direction the works are proceeding, in what situations the veins are mostly found to be productive, and what are the most likely places for prosecuting new trials, both with reference to the intersection of veins, and the strata in which they may be conveniently tried."

The preceding observations are contained in the introductory portion of the first edition of my Treatise on Isometrical Drawing, published in 1834, and in papers separately printed to accompany the engraved plans of mines which I had

previously published in 1828 and 1829. These illustrations of the subject met with the entire concurrence and approval of many persons eminently qualified to judge of their value, and subsequent observation has confirmed me in the belief that, under a proper and scientific system, not only would all the expenses of such surveys and plans be repaid to the present proprietors, but that an incalculable benefit would be conferred on the national interests; whilst, on the other hand, the continued neglect of such records will prove disastrous to the owners of mineral property, and destructive of the firmest foundations of national prosperity. Professional pursuits in various parts of Great Britain, as well as on the continent, have since afforded me abundant opportunities of studying the practical results arising from the preservation or neglect of mining records, and the present observations, hastily thrown together, are intended to add one more to the efforts which have been already made to awaken public attention, and to promote the adoption of a system so important to national interests.

In 1833 the state of the mines in Dean Forest, the property of the crown, rendered it indispensable that some means should be taken to prevent the serious mining difficulties and constant litigation which existed, and which had arisen almost entirely from the total absence of any methodical system of conducting and recording the mining operations. Great distrust of any interference existed, and some of the mine owners refused to allow of under-ground surveys being made. Nevertheless, on proper explanations of the mutual advantages to be derived from authentic data, surveys were eventually made, which enabled me, under the authority of the commissioners of woods and forests, to construct an entire plan of the forest, with its mines of coal and iron, showing not only the under-ground workings, but also the exact limits of the beds of coal and iron. Until these plans were completed there existed no basis on which to found any legislative enactment, or even to adjudicate in any way between the numerous and conflicting parties who were then working mines under customs which were totally inapplicable to the present state of mining; destructive at once to the interests of the free miners of the forest; ruinous, as sad experience had shown, to the enterprising capitalist, and subversive of the rights of the crown, which had, during the preceding half century, been almost entirely lost sight of from the circumstance of there being no attention paid to a

systematic improvement of mining practice in conformity with that of other mineral districts.

The transition from the ruinous state of the Forest mines to an amended system presents a striking evidence of the value of Mining Records, without which no such amendment could have been effected. The case is only a type of what exists in a greater or less degree in almost every part of the kingdom, and it is my object to show that the continuance of such a state of things is discreditable to us as a nation—that it will result in the loss of much valuable property—that it will inevitably cause many and fatal accidents—that it will materially lessen the productiveness and shorten the duration of our coal fields and other stores of mineral wealth—that it leads to continual litigation —to very frequent and serious injury to the rights of private property—that it is, in short, a public injury of the most serious character, worthy of the deepest attention on the part of the legislature, and tending more than any other subject to teach even this great and prosperous nation the sad lesson so briefly and eloquently expressed by Sterne, that "States and Empires have their periods of declension, and feel in their turns what distress and poverty is."

So great was the perplexity and so numerous and conflicting were the claims of contending parties in Dean Forest, that the law advisers of the Board of Woods deemed it almost impossible to arrive at any satisfactory adjustment of them within the period of three years, named in the Dean Forest Mining Act. This act received the royal assent on July 27th, 1838, and on that day three years afterwards the whole of the duties which had devolved on the Commissioners were entirely completed, to the entire satisfaction of all the three great interests affected by their adjudications. As the proceedings of the Commissioners were entirely based on the Mining Records which the Office of Woods had caused to be prepared, and as, without these records, not one step could have been taken towards the settlement of the mining questions in the forest, it is important, as an example, to show the successful result of this piece of legislation. It is in vain to urge on the public, reasonings which may appear specious, or arguments which, without illustration, cannot be understood. Still more vain is it to expect the legislative body to be guided solely thereby—it is, therefore, because the present case bears on the subject under consideration with all the weight of actual experience that I am anxious to elu-

cidate, First, the ruinous state of the Forest Mines arising from the want of Mining Records; Secondly, the completion of a survey and plans of the mines as an indispensable basis for effecting an improved system; and Thirdly, the satisfactory accomplishment of this important and desirable object by the Dean Forest Mining Commission.

1st. The ruinous and unsatisfactory state of the mines must appear obvious on a slight consideration. As no plans existed it was impossible to tell to what extent, or in what direction the under-ground works were being carried. The "crossing of mattocks," that is to say, the actual meeting of the workmen underground was often the abrupt signal for contention—the driving of narrow headings was a means by which one coal-owner might gain possession of coal, which of right belonged to another; and a pit, though sunk at a cost of several thousand pounds, had no secured possession of coal beyond 12 yards round it, that is, a tract of coal 24 yards in diameter. At 40 or 50 yards from such a work, another adventurer might commence a pit and have an equal right, if right it could be called, to the coal. If a long and expensive adit was driven, another one might be commenced only a few yards deeper, and, from such a state of things, it is quite clear that great uncertainty and frequent losses inevitably ensued. Litigation did little to remedy the evil, for the obvious reason that no accurate data existed on which to form a judgment. Attempts were made in some instances to establish surface boundaries, and one of these cases affords so good an example of the necessity for Mining Records, that with it I shall conclude this brief allusion to the state of the Forest Mines previous to the Dean Forest Mining Commission.

It was agreed by two parties that one of them should continue an adit in a south-west direction until it intersected a line between certain boundary stones fixed on the surface—with a heavy penalty if any trespass was made beyond the limits so agreed upon. A few years elapsed, and, as usual, no plan of the work was made, at length it became necessary to "dial," that is to ascertain with a magnetic compass the direction and extent of the adit. The surveyor entered the mine—he pursued the south-western direction of the original level which was to have been prolonged. Soon he began to distrust the instrument—the rising side of the coal, which alone had guided the miners, continued to be on his right hand, but his magnetic needle indicated first a south, then a

south-eastern—an eastern, and finally a *north-east* direction of an adit, which, under a heavy penalty, it had been agreed should go *south-west.* The trespass, which extended to many thousand square yards, amounted by the agreement to as many thousand guineas, and was ultimately settled by arbitration. It is in vain to multiply examples—similar cases of greater or less extent are known to have happened in every part of the kingdom where mines are worked.

But the loss of property, as between one proprietor and another, is the least part of the evil, nor could such losses or inconvenience, however great, be considered a national question, or one to which the attention of the public could be urgently called. It is quite true that the enjoyment of property above-ground is protected, and the abstraction of it heavily punished by law. It is equally true that this regard to the rights of property is at the very basis of social order, and if a land-owner were to appropriate his neighbour's fields to his own use, or attempt to renew the border rule,

> "The simple plan
> That they should take who have the power
> And they should keep who can,"

a stringent remedy would be soon applied. Nor is the spirit and intention of the law deficient as regards under-ground property when cases of spoliation and wrong can be clearly established; without a system of registration, however, there are great difficulties in the way. Many proprietors are altogether ignorant of the value of the minerals they possess —others are wholly uninformed of the extent to which such minerals have been worked, or for what period they are likely to continue—others have strong reasons to suspect that portions of their minerals have been unduly abstracted by adjoining proprietors, or laid open to the liability of serious loss by inundation or explosion, without their having any means to arrive at a knowledge of the facts. All these are serious evils, pressing with peculiar hardship on the parties interested; but yet, serious as they are, they are the least destructive of the consequences resulting from the want of Mining Records. The loss of such property, serious as it is to the owner, is a still greater loss to the public, and every case of inundation, or other destruction of mines, tends to accelerate, in a much greater degree than is generally supposed, the exhaustion of those stores of coal, the duration of which, as Professor Buckland has well observed, is "the

measure of the possible duration of our country's exaltep position among the kingdoms of the earth." The destruction or exhaustion of a mine becomes a source of apprehension and danger to the contiguous tracts of coal, and the loss of life which has already resulted from the want of Mining Records, will be fearfully increased as mines become deeper and more difficult to work, and more and more exposed, on every side, to the risk of explosion or inundation. I will not attempt to dwell on the awful calamities which have happened, or endeavour to excite feeling relative to a subject which requires calm and dispassionate enquiry. The fact that many lives have been lost, and the opinion of the best authorities, that the loss both of property and lives will inevitably ensue from the want of Mining Records, is at once sufficient to induce the attention of the public, and to lead to a full investigation of this momentous question.

My object is not to dwell upon what is well known and generally understood, but to show that the results which are so injurious and destructive on a small scale in particular districts, such as the Forest of Dean, *will inevitably be as ruinous and as fatal on a large scale, as regards the mining interests of the kingdom, unless a remedy is applied by a system of Mining Registration.*

2nd. The series of engraved plans of the Dean Forest Mines, prepared under the authority of the Office of Woods and Forests, are thus described in the observations accompanying the printed copy of the award, published by order of that board.

That part of the Forest of Dean and Hundred of St. Briavels in which the mines are chiefly situated extends over an area of which the extremes are respectively eight miles from north to south, and a like distance from east to west. Of this district an exact surface and subterranean survey was made in 1835, by Mr. Thos. Sopwith, for the Commissioners of Woods and Forests, and the plans then made have since been engraved for the use of the Dean Forest Mining Commission. As impressions can be had from the copperplates at an extremely moderate cost, an opportunity is afforded to all persons interested in the Forest mines of having plans thereof, and this method of preserving accurate records of mining operations possesses several advantages, when considered in connexion with the vast importance of a knowledge of the mineral treasures of this country.

An index map inserted in the volume forms the sixteenth

sheet of the entire series, each sheet being of the same dimensions as the index map, and numbered so as to correspond with the small squares on the latter. The scale of the index map is two and a half inches to one mile; each compartment, therefore, comprises four square miles, and each sheet of the large map in detail contains in like manner a separate area of four square miles, the scale of the large map being ten inches to a mile, or eight chains to an inch. By means of the index map, therefore, any one may ascertain what particular square or squares of the larger map are wanted in illustration of the mining operations in any part of the Forest. These sheets, each comprising a plan of four square miles or 2560 acres, may be purchased at the rate of 2s. for each sheet, or 24s. for the entire series of sixteen sheets. They are printed on stout drawing paper, so as to admit of any additional planning being laid down upon them; and a broad margin is left at one side for the purpose of inserting any remarks, drawing sections of strata or other details which would encumber the area of the plan, but which it is desirable should be seen in connexion with it.

The delineation of surface objects in these plans is confined to roads, railways, rivulets, boundaries of the Forest, and of its several inclosures; and of such objects generally as are easily recognized, and of a description not liable to sudden or frequent alteration: avoiding those minute details which, on a complete surface plan, would interfere with the clearness of the subterranean delineations. For the same reason the trees are not represented over the whole area of each inclosure, but only at the borders, and on the index map; owing to the smallness of the scale, a few of the principal underground levels only are shown, and none of the workings, as in the large plans, to which the following description refers.

The several seams or veins of coal are represented by parallel lines, at the distance of ten yards, according to the scale, by which means an approximate idea of small distances and areas may easily be formed. These lines are either parallel to, or inclined at certain angles with the top and bottom lines of the plan; and each variety of inclination designates a particular seam or vein of coal. The Coleford High Delf vein is represented by straight lines directly across the plan in an east and west direction. The Park End High Delf is shown by lines pointing seventy degrees west of south.

The Smith Coal by wavy lines pointing forty-five degrees east of south. The Churchway vein by straight lines parallel to the meridian, and so in the case of nine different veins, the shading of which is explained by a reference in sheet No. 12, and by the enlarged sections on several of the plans. The extent of shading on the plans represents that portion of each vein which has been worked out or exhausted, and the principal works now in operation are shown by straight, or dotted, or wavy lines of various kinds, as described in the reference. When, therefore, any plan is to be appropriated for colouring or making additions to the works in any particular vein, it will facilitate a clear understanding of the same, if the lines representing the outcrop of that vein be coloured between each alternate line; and this mode of colouring may also be adopted to represent workings in that vein belonging to other parties than those whose mines are more immediately the subject of delineation. In the latter case, the colouring may extend between each line without leaving a space uncoloured between the alternate lines, and in addition to this distinction it will be still more explanatory to apply different colours to the mines belonging to different owners.

These plans form the first instance of a regular series of mining plans prepared and published by order of the English government. I am far from contending that they are suitable models for imitation, nor can it fairly be expected that any first example should be so. I have detailed the particulars relating to them, because they form a commencement of a system which I believe to be worthy of adoption in all mining districts; and, I have no doubt, that whenever the attention of the mining public is bestowed on the subject, many valuable suggestions and improvements will be made. It is enough for my present object, to state that these plans were found to be adequate for their intended purpose: the entire series of them, mounted on cloth in one plan, may be seen at any time in the Museum of Economic Geology, or purchased in sheets, together or separately, at a price scarcely exceeding the actual cost of paper and printing, by any bookseller, from the publisher, Mr. Weale, 59, High Holborn, London. This step in Mining Records is at least *something done*, and that is so far gratifying in a matter upon which, for more than half a century, so much has been ably written, without any further progress being made.

Even plans and sections, in some cases, can scarcely

convey a clear idea of the intricacies of geological structure which occur in mining, and which, as in the example of Dean Forest, just recited, have an important influence on mining operations. In preparing a bill for parliament relative to the Dean Forest mines, some of the details were so apparently paradoxical that it was doubted whether they could be made apparent even with the aid of plans. In order to exhibit the general conditions of the mining field, I submitted to the Commissioners of Woods and Forests the expediency of having a model constructed, which, by being dissected, should present to the eye a correct view of the relative position of the different beds of coal, their depth from the surface, their denudation in vallies and other particulars affecting their value. This suggestion being approved, led to the construction of the models which are now placed in the Museum of Economic Geology: they were constructed on an entirely new principle, which I exhibited and explained to the British Association in 1838, and which I have since applied in numerous instances for the illustration of similar geological and mining purposes. By means of the plans and models the whole of the general features of the Forest, both above and underground, were clearly exhibited, and the modelled representations have been favoured with the approbation of many persons of distinguished rank—among whom I may mention the names of His Royal Highness Prince Albert, the Marquesses of Lansdowne and Northampton, Lords Duncannon and Lincoln, and the other Commissioners of Woods and Forests. Duplicates of these models have been adopted by the professors of geology at Oxford and Cambridge, and they, as well as Sir Henry De la Beche, Mr. Murchison, Mr. Greenough, and other eminent geologists and miners, have concurred in expressing their approval of them as valuable auxiliaries in any system of preserving geological and mining records.

Having noticed, though briefly and imperfectly, the mischief arising in Dean Forest from the want of Mining Records, and described the plans and models which were prepared in order to remedy those defects, I come in the third place to speak of the results.

Any opinion, however, that I might venture to express as regards the success of labours in which it was my duty, as Commissioner for the Crown, to take an active part, must necessarily be received with some limitation as coming from a party concerned. At the same time, I am anxious that

the experiment tried in Dean Forest should be fully understood, and to avoid the appearance of partiality which any views of my own might appear to possess, I will, on this head, confine myself to the official letters forwarded from the Office of Woods to my colleagues,* and myself on the completion of our labours;—

[No. 1.]

"To the Dean Forest Mining Commissioners.

"Office of Woods, 26th Aug., 1841.

"GENTLEMEN,

"I have, on behalf of the Commissioners of Her Majesty's Woods, &c., to acknowledge the receipt of your letter dated the 28th ult., intimating the completion of your labours in the Dean Forest Mining Commission, under the Act 1st and 2nd Vict., cap. 43, for regulating the opening and working of mines and quarries in the Forest of Dean and Hundred of St. Briavels, and I am in the name of this Board to convey to you their entire approbation of the zeal, ability, and sound discretion which appear to the Board to have marked all your proceedings in the performance of the very important, difficult, and laborious duties which devolved upon you, and their belief, that while the result will be very beneficial to the interests of the Crown, it will be attended with equal advantage to the great body of mining adventurers, in securing their titles to the property on very reasonable and moderate terms, and subject to the regulations and conditions, which seem to be well calculated to protect them from that constant and expensive litigation which had so long existed.

"I am, Gentlemen,

"Your most obedient servant,

"A. MILNE."

[No. 2.]

"To Thomas Sopwith, Esq.

"Office of Woods, 26th August, 1841.

"SIR,

I am, on behalf of this Board, to acknowledge the receipt of your letter, dated the 28th ult., stating that the labours of the Dean Forest Mining Commissioners had been concluded on the 26th, being the day previous to the expiration of

* John Probyn, Esq, of Longhope Manor House, Gloucestershire, and the late John Buddle, Esq., of Newcastle on Tyne.

the Act under which they had performed their duties, and I am to state to you, that while the Board is much gratified by your testimony of the able and efficient co-operation of those who were joined with you in that very arduous service, they are well satisfied that the interests of the Crown, more immediately confided to your protection, have been very faithfully and ably represented.

"I am, Sir,
"Your most obedient Servant,
"A. MILNE."

Many other, and striking instances of the value of Mining Records might be adduced, but most of them are more or less connected with the interests of private individuals, and, arising in the course of private professional practice, are not available for publication. There are, however, a great number of persons who have had abundant experience of the evils flowing from the want of a regular system of registering mining operations—evils which will assuredly increase, and ere long become irreparable, if England continues to be the only European state which neglects the important and vital question of the statistics of mining.

It is in vain to multiply words in any lengthened arguments on a subject which has been so often and ably commented upon—my object is rather to point out the broad features of the case—to direct attention to the mode of constructing mining plans and records—to invite, if possible, the public attention to the weighty reasons which have at various times been brought forward, and to the efforts which have been made to arrest the attention of the legislature. In a subject so largely mixed up with a knowledge of geological structure and mining experience, it is of no small moment to bring prominently forward the names of those who have taken a lively interest in it. The Council of the British Association from the talents and experience of its members, is eminently qualified to form a sound judgment on this scientific question of national policy and statistics, and to it I submitted, in 1838, a paper entitled "SUGGESTIONS ON THE PRACTICABILITY AND IMPORTANCE OF PRESERVING NATIONAL MINING RECORDS." The following extracts from this paper may serve to point out some of the general views which were then recognised, and which resulted in the formation of a Mining Records Committee as related in the sequel.

"That the prosperity of Great Britain depends mainly on its MINERAL PRODUCTIONS, is too obvious to require comment. It follows from thence, that whatever tends to promote economy in mines, and to afford increased facilities for obtaining their products, is deserving of the attention of every one who would secure the future as well as the present welfare of the country.

"Of the great value of, and the necessity which exists for, a regular system of preserving mining records, so much has been said by the most eminent and experienced geologists and miners, that it requires some apology for again adverting to it: that apology, however, is best made by mentioning the fact, that hitherto no regular or extensive system of preserving mining plans has yet been adopted in this kingdom. It may not, therefore, be entirely without its use to solicit the attention of the British Association to a matter so closely connected with the interests of science as well as commerce, and indeed with the welfare of the community at large; nor, if the subject be deemed worthy of attention, could it be more appropriately brought before the society than during its meeting in the midst of the mining districts of the North of England."

"It is not, however, so much with reference to particular mines or mining districts, as to a general and national system of preserving mining records, that I submit these observations to the scientific body now assembled at Newcastle. The advantages of preserving such records partake as largely of national benefit as of private interest to the owners of landed property. The former of these is under the guidance of the statesman, but no means have yet been devised by which individual enterprize could be directed to such an object. The circumstance of most mines being held only for a limited term of years naturally occasions an indifference to the future state of the workings, and even the owners of mines too often confine their attention to a limited prospect. Many persons are altogether insensible to the nature of the advantages proposed to be gained by preserving accurate mining records, nor can private individuals effect that careful and permanent preservation, or afford the inspection to others, which could only be accomplished by a public institution. Of the necessity for mining records there can be little doubt in the minds of those who know how immediately the national welfare depends on the mineral products, and how very much the obtaining of these products depends on an accurate know-

ledge of what has previously been done, especially in mines which have been long abandoned. The authorities I have quoted form as strong a testimony as the best mining experience can furnish, and the general merits of the question are well appreciated by scientific and practical men. If the importance and practicability of a national system of preserving mining records should be admitted, there are few more definite objects (combining, as it does, general science and national usefulness) for the British Association to promote than this, of obtaining the aid of the legislature and the support of the large mine-owners to a REGULAR, SYSTEMATIC, AND PERMANENT RECORD OF THE MINING OPERATIONS AND MOST IMPORTANT GEOLOGICAL PHÉNOMENA OF THESE KINGDOMS."

This led to the appointment of a Committee, and other proceedings, as detailed in the following memorandum: --

MINUTE OF RESOLUTIONS PASSED BY THE COUNCIL OF THE BRITISH ASSOCIATION, AT THE MEETING IN NEWCASTLE-UPON-TYNE, AUGUST 25TH, 1838.

1st. That it is the opinion of this meeting, that with a view to prevent the LOSS OF LIFE AND OF PROPERTY WHICH WILL INEVITABLY ENSUE FROM THE WANT OF ACCURATE MINING RECORDS, it is a matter of NATIONAL IMPORTANCE that a depositary should be established for the collection and preservation of such Mining Records of subterranean operations in collieries and other mining districts.

2nd. That a committee be appointed to draw up a memorial, and to communicate with the government in the name of the British Association respecting the most effectual method of carrying the above resolution into effect.

3rd. That the committee consist of the following gentlemen with power to add to their number:—

The Right Hon. the MARQUIS of NORTHAMPTON, SIR CHARLES LEMON, Bart., M. P., SIR PHILIP G. EGERTON, Bart., JOHN VIVIAN, Esq., DAVIES G. GILBERT, Esq., J. S. ENYS, Esq., W. L. DYLWYN, Esq., CHARLES LYELL, Esq., THE PRESIDENT for the time being of the GEOLOGICAL SOCIETY of LONDON.—THE PROFESSORS of GEOLOGY in the Universities of OXFORD, CAMBRIDGE, LONDON, and DURHAM. H. T. DE LA BECHE, JOHN TAYLOR, JOHN BUDDLE, and THOMAS SOPWITH, Esqs.

In pursuance of the above resolutions a Meeting was held

at the Offices of Mr. Sopwith, in the Royal Arcade, Newcastle, on Monday, August 27th, 1838, present—

SIR CHARLES LEMON, BART., IN THE CHAIR.

The Rev. Dr. Buckland—The Rev. Professor Sedgwick—Professor Phillips—Professor Johnson; John Buddle, Thomas Sopwith, and Richard Griffith, Esquires.

It was proposed by Dr. Buckland, and seconded by Mr. Sopwith.

That Richard Griffith, of Dublin, Robert Bald, of Edinburgh, and J. Barker, of Bakewell, Esquires, be added to this Committee.

It was proposed by Dr. Buckland, and seconded by Mr. Buddle—

That Secretaries be appointed as follows:—

John Taylor, Esq, F.R.S., F.G.S. General Secretary. Thomas Sopwith, Esq., C.E., F.G.S., for North of England. Richard Griffith, Esq., C.E., F.G.S., for Ireland. Robert Bald, Esq., C.E., F.R.S.E. for Scotland.

Dr. Buckland having read the Resolutions passed by the Council of the British Association, the following Memorial was drawn up, and having been approved, Sir Charles Lemon undertook to transmit it to the Chancellor of the Exchequer, which was accordingly done.

COPY OF THE MEMORIAL OF THE MINING RECORDS COMMITTEE,

To the Right Honourable the Lords of Her Majesty's Treasury, &c.

The Memorial of the Committee for the Preservation of Mining Records appointed by the British Association for the promotion of science, assembled at Newcastle, August 25th, 1838,

Humbly sheweth,

That whereas it hath been made apparent to your memorialists, that great loss of life and destruction of property have resulted from the imperfect preservation of Mining Records; and whereas still greater losses will inevitably ensue unless advantage be taken of the experience of living individuals, who are willing to place in any public depository that may be provided, copies of the numerous mining documents now in their possession.

And whereas, the preservation and economical use of mineral produce, and especially of coal, are of great importance not only to the proprietors of mines, but to the nation at large.

Your memorialists feel it to be their duty respectfully and earnestly to call your lordships' attention to the expediency of establishing as soon as possible a national depository for the preservation of documents recording the mining operations of the United Kingdom.

That the experience of the neighbourhood of Newcastle, within the personal knowledge of several of your memorialists, affords appalling examples of the loss of life, and waste of highly valuable mineral property, which would never have occurred, had such documents been preserved as it is now the object of your memorialists to collect. As in the lapse of time, mining operations become of necessity more complicated and dangerous, the risk of the recurrence of similar catastrophies will be continually increasing. It appears to your memorialists that the only sure and effectual means of preventing these deplorable results is the establishment of such a public office as has already been alluded to.

The practicability of carrying out the above measures, has been shown by what has recently been done under the direction of the Board of Woods and Forests, in the case of the coal mines in the Forest of Dean, and by the documents relating to the coal mines of Newcastle which have been deposited by Mr. Buddle in the archives of the Natural History Society of Newcastle. It is within the knowledge of your memorialists that an immense number of similar documents are in the possession of individuals who are now willing to place copies of them in any public depository, under the controul of government.

Your memorialists therefore humbly pray that your lordships will be pleased to take the premises into your consideration.

(Signed) CHARLES LEMON, *Chairman.*

This representation to the government, followed up by the zealous advocacy of the Marquis of Northampton and Sir Henry De la Beche, led to the arrangements which are now being carried into effect; and at a meeting of the Mining Records Committee in March 1839, it was considered that no place of deposit could be more suitable than one in connection with the Museum of Economic Geology. On the recommendation of Sir H. De la Beche, Mr T. B. Jordan was appointed keeper of Mining Records on October 10, 1840, in virtue of which appointment, the several plans, sections, implements, and models appertaining to this department, are placed under his care.

The following notices of the Mining Records Office, thus established, appear in the published addresses of Dr. Buckland as President of the Geological Society, 1840 and 1841.

"To the keeper of these records will be assigned the duty of arranging the documents which may be transmittted to him from all parts of the kingdom, by any engineers, mineral surveyors, and proprietors of mines and coal works, who may be willing to send them; particularly maps, sections, and under-ground plans, which will record the state of each mine, when it is abandoned, for the information of those who, at a future period, may be disposed to bring it again into operation. This office will be accessible to all persons interested in obtaining the information it will afford. To this collection several engineers of most extensive experience in the mines of Newcastle and Cornwall have promised large contributions.

"The keeper will make copies of documents of this kind, which proprietors of mines who cannot conveniently part with the originals may lend, for the purpose of being preserved in this national collection."—*Annual Address, Feb.* 20, 1840.

"Here will be also large collections of models illustrative of machinery used in mines, as well foreign as British; so that not only will the British miner be enabled to compare the machinery employed in different parts of his own country, but he will also find that adopted in foreign countries. It is understood that any one desirous of making drawings of these models, for the purpose of erecting machinery from them, will be permitted to do so under proper regulations.

"In addition to this collection of models of mining machinery, there will be other models illustrating the mode of working mines in different localities. A very beautiful model of the celebrated Dolcoath mine in Cornwall is now in the collection; and we understand that Mr. Sopwith is preparing for this museum models of the coal-fields of the Forest of Dean, and of Northumberland and Durham. Models illustrating the mode of working coal, and of ventilating the collieries in the North of England, are also in preparation.

"From all these the public may receive VALUABLE, CONDENSED, and GRATUITOUS INFORMATION as to the mode of the OCCURRENCE OF MINERALS within the earth, the various methods of WORKING MINES, and the MACHINERY by which coal and metallic ores are brought to the surface and fitted for the market. There will be also models illustrating the

metallurgic processes, and samples of the various stages of these processes, and their final results.

"The agriculturists are availing themselves of the facilities afforded by the laboratory, and analyses of soils have become numerous. It is in contemplation, also, to have lectures on various branches of economic geology, including building materials, agricultural chemistry, geology, mineral analysis, and metallurgy."—*Annual Address, February* 12, 1841.

These notices are introduced in order to show that the establishment is based on solid grounds, and sanctioned by the highest scientific authorities, as well as called for by the urgent necessities of the case. Much has already been done, *but much more remains to be done;* and hence it cannot be too frequently or too earnestly impressed on public attention, *that our greatness as a nation wholly depends on the prudent economy of our mineral wealth.* Without diligent attention to this subject, the eloquent declamations of Werner may ere long be again poured forth by witnesses of the rapid declension and unavoidable decay which must ensue if accurate records of subterranean operations are not preserved in the manner, and for the objects briefly indicated in the preceding pages.

The establishment of an office of Mining Records by government, under the direction of one so well qualified to promote its objects as Sir Henry De la Beche, cannot be regarded as otherwise than a most satisfactory step towards the objects which it is the purpose of these observations to advocate. In connection with the Museum of Economic Geology, and the laboratory of Mr Richard Phillips, it forms a most valuable place of study for all who are interested in mining pursuits, as well as for the architect, the builder, the agriculturist, the artist, and the artizan. The establishment already contains a great number of plans, sections, models, and specimens, which, taken in connection with each other, convey extremely accurate notions of the general modes of conducting mines. A large and elaborate model by Mr. Jordan, the keeper of Mining Records, presents an admirable view of the interior of a Cornish mine, accompanied by explanatory modelled details, and by examples of the various ores extracted from thence. Models by the late Mr. Buddle exhibit the mode of ventilation introduced by him in the collieries of the north of England, with exact sections showing the structure of many of the principal

seams. Several models and plans, which I have prepared for the institution, illustrate the general conditions of the strata and mining operations in the coal and lead mine districts of the north of England, and of the coal and iron mines in Monmouthshire, &c. Of these and similar models Sir Henry De la Beche has observed, that they "constitute a miniature representation of nature which, if faithfully executed, and the workings, if any, correctly marked, cannot fail to be of great value in mineral districts." A great number of extremely valuable models of mining machinery have also been collected, and the institution, though quite in its infancy, is nevertheless replete with interest and instruction. Placed, however, in an obscure court, without any distinguishing feature to attract public attention, the place is scarcely at all known, and the funds appropriated to it by government are far short of what the value of such an institution demands. The same zeal and energy on the part of Sir Henry De la Beche which led to the establishment of the Museum, will, it is hoped, be successful in gaining the continued and increased support of government to this valuable establishment.

Excellent, however, as this institution most assuredly is, it is quite evident that no material progress has yet been made towards the great object of a "REGULAR, SYSTEMATIC, AND PERMANENT RECORD OF THE MINING OPERATIONS OF THESE KINGDOMS," which was the object expressly recognized by the British Association in 1838. Scarcely any publicity has been given even to the existence of a Mining Records office, except in a small work, which I published last year, describing the general nature and objects of the Museum of Economic Geology. * Indeed, the present scale of the institution, utterly precludes all recognition of it as a great national depository for mining plans, nor is it at all likely that any considerable progress can be made until the matter is viewed by the public in all its ample bearings, and enforced by legislative authority.

It is supposed by many that the advantages of preserving Mining Records are wholly prospective—that it is for the benefit of posterity alone, and that the present generation

* This little volume is sold at the Museum of Economic Geology, at a price considerably under the actual expences of the mere printing and paper, and I also distributed a great number of copies gratuitously, with a view of making the Institution more extensively known.

may safely run riot with our supposed *inexhaustible stores of coal.*—Upon this subject there exists a *most unfounded security.*—The opinion that our stores of coal are all but inexhaustible rests wholly on assumed data, and not upon any accurate and detailed statistical accounts such as alone could warrant a confident opinion. This question will, ere long, become a subject of serious concern, unless some measures are taken to found our calculations on a solid basis. It is an easy matter to assume, that a considerable thickness of *available coal* extends over hundreds of square miles, but the different opinions formed by men of the highest respectability and talent, strongly proves how meagre and unsatisfactory are the only data on which their estimates are founded.

It is not, however, the mere quantity of coal that is to be considered. Especial regard must be had to its quality—depth—thickness—extent, and position. Many of the inferior seams can only be worked *in conjunction with those which, by their superior quality, repay the expense of working them at depths varying from* 300 *to* 600 *yards*, and it may readily be conceived that *inferior coal only* could not be profitably raised from pits equal in depth to three or four times the height of St. Paul's Cathedral, unless the price of such inferior coal was raised to more than the present price of the best coal. It is the additional expense and consequent additional difficulty of competing with other countries that is the vital question to be considered. It is not the exhaustion of mines, but the period at which they can be profitably worked, that merits earnest and immediate attention, and it is with especial reference to this that the value of and increasing necessity for Mining Plans is so strongly apparent. If these inferior seams are not worked now, in conjunction with the better seams, they will, in all probability, be wholly lost, and to a certainty they must be so, if no permanent registration is adopted to show what were the former circumstances of each mine. On a late occasion a duty was laid upon exported coal, and one view that was taken by members of the legislature and others, was that of limiting exportation in order to perpetuate our own supplies. Instead of this, however, a slight examination will suffice to show that a very different result will in many cases ensue, and that coal which may now be exported with great advantage to the coal owner—to the mining population, and to the shipping interests, may be

shut up by the prohibitive effect of such duties until the coals of better quality are exhausted, the mine closed or suffered to lie dormant, and the coal, instead of being preserved, remain buried for ever, to the great loss of the nation, and the discredit of government, whose first duty it is to preserve with religious care, so material—so indispensable an element of the nation's greatness, as its mineral wealth. It is not my intention here to enter upon lesser questions, or upon details of policy; I only refer to them so far as they serve to illustrate the general principles I am advocating. If, as I have been informed, 20,000 tons of Belgian coal have last year superseded as much Newcastle coal in one market on the coast of France, the question, whether that quantity of coal has been preserved for future use, or is utterly lost, is surely worthy of the legislators' attention. Without mining records, and mineral statistics, government has no guide, and with intentions which, at first sight, appear to possess a specious advantage, they may be inflicting a deadly wound, not only on mining and shipping interests, but on the vital sources of national prosperity.

It would extend these observations to an unreasonable length, were I to describe the very different and surely more prudent course pursued by continental states. I shall, therefore, confine myself to a few particulars relating to the mines of Austria and Belgium, as illustrations of mining education and mining registration, for the one it is quite clear ought to, and indeed must inevitably, accompany the other.

In the education of persons to fill the situation of mining directors, &c., a regular system is pursued in the mines of Austria and Hungary, respecting which I learnt several particulars from the accomplished director of them, Count Augustus Breunner. The management of these mines is confided to those only who have availed themselves of, and profited by, the means of instruction which are liberally and judiciously afforded by the Austrian government, to whom most of the minerals belong; but in Hungary and Bohemia the coal, as in England, belongs to the owner of the soil. About one-third of the mines are worked by government, and the remainder by private individuals or companies; the duty, which is one-tenth of the gross produce, is mostly paid in money. I mention this because an impression prevails that the mines are wholly in the hands of government. All persons at the age of 18 are eligible to be admitted into the

School of Mining at Schemlnitz, where lectures and instructions are given by professors, who are paid by government. During the first year the student learns mathematics and mechanics, studying also the application of various mechanical contrivances by means of models. The lectures are given six days in each week and nine months in the year. In the second year, chemistry is pursued, together with the art of smelting and assaying. A Laboratory is provided* in which experiments are tried, the materials being provided at the expense of government. In this second year, also, the students visit the mines to inspect the various operations, which are explained by the professor who accompanies them. These visits to the mines are made twice a week.

In the third year the student learns the art of mining from lectures, and *in the mines.* He studies the art of surveying and planning, by which his knowledge of mathematics is constantly exercised, and he learns not only the theory, but also *the practice of mapping mines,* by comparing his work with the *actual working plans of the mines.* In the mining schools of Freyburg, the students are required to work in the mines: this is not enforced in Austria, but the opportunity of doing so is afforded, and many of them avail themselves of it.

The fourth year is occupied in practical observation and superintendence of mining operations—the smelting, washing, and dressing of ores, and during the whole of this year the whole of their previous knowledge is directly applied to the investigation of practical workmanship in the several departments of mining.

The four years of mining instruction are thus divided into regular periods, during which separate departments of art and science are studied, and the mind is not distressed with that multiplicity of studies, which is the bane of English

* I am anxious to give publicity to the arrangements (scarcely at all known to the public), by which any person may obtain instruction in these departments from Mr. Richard Phillips, F.R.S., who fills the post of Curator of the Museum of Economic Geology, and has an extensive laboratory in connection with that institution; and I may here observe, that a still more extensive laboratory, with all means and appliances for study, is conducted with great ability by Mr. Thomas Richardson, in Newcastle on Tyne. Mr. R. was a pupil of Liebig's, and is well skilled in analytical chemistry. The extensive arrangements which he has made, are admirably adapted as a School of Chemistry in which all persons connected with mines and manufactories and agriculture may obtain instructions on exceedingly moderate terms.

education. The professors are four in number, viz., mathematical, chemical, surveying and planning, and the practice of mining.

Although no establishment for general mining instruction has been established by the British government, an effort was made a few years ago by Sir Charles Lemon, to confer on the County of Cornwall a School of Mines. Even the munificent offer of ten or twenty thousand pounds as an endowment for such an institution failed to overcome the prejudices which would fain retard scientific improvement, and, unless controlled by the power of an enlightened government—backed by public opinion, this indifference to mining improvement will, ere long, become a calamity, the deplorable extent of which will not be fully understood until the time for applying any remedy has wholly passed away.

In Belgium the produce of the coal mines has greatly increased, and in recent visits which I have made to that country, I found its most interesting and valuable mineral districts as yet very imperfectly developed. The district of the Sambre and the Meuse contains extensive coal fields—vast deposits of iron ore—inexhaustible supplies of marble and a great abundance of slate. Not only has it been the policy of the government to provide accurate maps of the surface, and equally accurate maps of geological structure, but all manner of details relating to the mines. The general nature of these records I shall briefly notice, premising that they form accurate data, upon which either legislative enactments or engineering projects may safely rest.

A mineral map, prepared by the accomplished geographer Vandermælen, exhibits the position and extent of every mine in the kingdom, each being distinguished by a number. A report to the King, of which I received a copy, refers to each number, and states, relative to Coal Mines.

1st. The name of the mine.

2nd. The name of the commune on which it is situated.

3rd. The date of the concession.

4th. The extent of surface "conceded" and "provisionally attributed."

5th. The number of works being carried on.

6th. The depth of the mine.

7th. The number of the beds of coal capable of being worked.

8th. The names of those which are actually being worked.

9th. The thickness of the beds of coal being worked.
10th. The means of ventilation.
11th. The modes of extracting the coal and the power of engines, &c., employed.
12th. The means of drainage and power of engines, &c.
13th. The number of workmen employed.
14th. The quantity of coal extracted.
15th. The quality and use of the produce of the mine.
16th. The means of communication for carrying away the produce.
17th. Miscellaneous explanatory observations.

Equally detailed particulars are kept of the iron and other mines, of the number of steam engines and quantity of coal consumed, &c., nor are those records less complete with reference to accidents, giving in addition to the
1st and 2nd columns above noticed.
3rd. The number of accidents.
4th. The date when they occurred.
5th. The nature of the accident.
6th. The cause of the accident.
7th. The number of wounded in one column, and killed in another.
8th. Damages occasioned to the works, &c.
9th. Descriptive particulars and remarks.

Of the amount of coal which has been worked, and of the probable quantity yet remaining to be worked in Great Britain, there is no source from which any rational conjectures can be founded. Without attempting to add to the number of conjectures, which are as various in their results as they are unsatisfactory in respect of the principle of calculation, I would rather direct attention to the facts, that, be the duration long or short, no solid estimate can be formed without mining records. That, be it long or short, the period of exhaustion will be greatly accelerated by the want of such records. That the quality, and not the quantity of coal, is the chief element for consideration, and that in the collieries of the River Tyne, which formerly were the chief source of supply, the best quality of coal is already exhausted. That the consumption of coal, by a greatly increased population, by more luxurious habits, by steam boats, locomotive engines, and manufactories, very far exceeds any of the estimates of consumption formerly used, that vast quantities of coal may be wholly lost, if not worked in conjunction with other

seams, and that considerable loss of life, and destruction of property, will inevitably ensue, from the continued neglect of mining registration.

Of the amount of exhaustion and variable quality of the seams in Northumberland and Durham, the principal coal field of Great Britain, the following extracts from an able paper, by the late Mr. Buddle, read to the Natural History Society of Northumberland, Durham, and Newcastle-on-Tyne, in 1830, are illustrations which strongly indicate the necessity of observing due economy in what yet remains to be worked.

Mr. Buddle in this paper observes, that the several seams vary, not only in thickness and quality in different parts, but also in quantity—almost all of the seams of coal become more or less deteriorated in quality, whenever sandstone happens to form their immediate roof—the degree of deterioration is always greatest when the sandstone forms the immediate roof of the seam, and is in actual contact with the coal.—Besides being deteriorated by a sandstone roof, the coal is almost invariably more or less intermixed with iron pyrites under such a roof.—In further detail, Mr. Buddle, who for more than half a century was intimately conversant with the subject, describes the coal seams in the vicinity of Newcastle as follows:—

"A. The Monkton and Hebburn Fell Seam, the first of the series, extends over a very limited tract of country, being denudated and cut off by the river Tyne to the north, and is thrown out to the surface on the S.W. and W. by a slip dyke and the natural rise of the strata.— The coal is of inferior quality and is interstratified with stone bands. It cannot be wrought with profit at this time.

B. The Three Quarter Coal– is of very uncertain thickness and inferior quality.

C. The High Main Coal is the best seam in the district in point of thickness and quality. It becomes unworkable at a short distance to the south of the Tyne, by being interstratified with a stone called the Heworth Band.

The seam extends over a large tract of country to the north, but varies much in thickness and quality in that direction.—A great part of the seam in the tract west of Newcastle, was destroyed by a conflagration in the middle of the sixteenth century, and the remainder has been entirely wrought out.

D. The Metal Coal Seam is of second-rate quality, and has only been partially worked.—In the north-western parts of the district, it is not in a workable state.

E. The Stone Coal is not a workable seam in any part of the district at this time, except at Seghill and Cramlington Collieries, where it is united with the metal coal.

F. The Yard Coal seam is of inferior quality, with a bad roof, and does not exist as a workable seam in many parts of the district.

G. The Bensham Seam.—The coal is of second-rate quality, with a mixture of scare bands, or slate and splint coal. It is an excellent gas coal, and the splint is in great demand for steam-boats and steam-engines. The seam does not exist in many parts of the district, particularly in the north-west part."

H. The Six Quarter Coal is not workable to profit at this time in any part of the district. Its presence and thickness are both very uncertain.

I. The Five Quarter Coal.—The description of the six quarter coal applies to this also.

K. The Low Main Seam.—This seam is not worked at present in any part of the district on the north side of Tyne, except at Collingwood Main. Wherever it has been worked it has been found of inferior quality. The coal is tender, and burns to white ashes.

L. The Crow Coal.—Not of workable thickness.

M. The Ryton Five Quarter Coal.—Not of workable thickness.

N. The Ryton Ruler Coal.—Not of workable thickness.

O. The Beaumont Seam is not deemed workable to profit in any part of the district at this period, and has not been found in many parts.

P. Q. R. S. have not yet been found.

The above comprise all the coal seams in the "Newcastle Division" of Mr. Buddle's Synoptical Table.—The other three divisions, in too many instances, present similar cases of deterioration and exhaustion. For full information the reader is referred to the records of the Natural History Society's Transactions, p. 220; and the following brief memoranda are added to show how large a number of seams are circumstanced so as greatly to diminish the anticipations that are formed by a mere reference to their number and thickness. The same letters may be

considered as representing as nearly as the case will admit, the seams of coal corresponding to the enumeration in the Newcastle Division.

In the River Tyne subdivision, west of the meridian of Newcastle, A. and B. do not exist. C. is not workable to profit at present, and only extends over part of the district. D. and E. united form one seam, which is wrought out over great part of the district. F. is also worked out over great part of the district. G., H., and I., united, form the Hutton Seam. This, the finest seam in the district, is now greatly exhausted.

K. is not workable to profit at present.

L., M., and N., are all under workable thickness.

In the Ryton and Walbottle district, embracing the whole of the coal-field west of the meridian of Newcastle, on both sides of the Tyne, and north and west of the Derwent, A., B., C., D., E., F., G., H., I., are all cropped out in this district, that is, they do not exist at all. K. varies much in quality in different parts of the district, but is mostly of inferior quality, and in many parts it is very bad. L., not of workable quality and thickness. N., not of workable thickness O. has been extensively worked. P. varies in quality and hardness. Q. is a coal of good quality, but tender, and works small. R. is not found in a workable state at Walbottle. S. yields coal of various qualities, and has been extensively worked. This is supposed to be the lowest or last workable seam in the series.

In the River Wear subdivision, east of the meridian of Chester-le-Street, A. and B. are not recognised. C. is of very inferior quality, and not workable to profit at this time. D. and E. united form one seam, yielding coal of inferior quality—has been extensively worked in some parts of the district, but is not workable to profit in others. F., though generally of good second-rate quality, is very bad in some parts, and has been extensively worked. G. is not workable in many parts of the district. H. is not found in the greater part of the district, and nowhere in a workable state. I. is nipped out, or has not been deposited in some parts of the district. Where found in perfection, it has been extensively worked. K., which lies through the whole district, has been extensively worked. L., M., and N., have not been found in a workable state.

In the only remaining division west of Chester-le-Street, A. and B. are cropped out; C. varies greatly in quality,

and is only worked in Beamish Colliery; D. and E. form one seam, variable in quality, and extensively worked; F. extensively worked; G. very uncertain in point of thickness and quality; H. is not found; I. extends throughout the whole district, is an inferior seam, and is not at present worked for sea sale; K. has only been partially wrought, and in some parts is not workable to profit; L., M., N., O., P., Q., R., S., not yet explored.

These extracts, from the able synopsis of Mr. Buddle, abundantly prove that a great number of the coal seams of the Tyne and Wear are at present unworkable to profit, owing to the demand for the superior qualities of coal with which the metropolis is now furnished from the mines of the county of Durham. It is, as compared with these finer descriptions of coal, that many of the above seams are characterized as inferior, for as compared with the coal of other districts, they merit a very different appellation. Some of these seams can only now be worked in conjunction with more valuable coal; but others must remain until a demand arises. The question of Mining Records practically amounts to the conservation of all such seams; for assuredly if such records are neglected, a very large proportion of these beds of coal will be entirely lost.

The whole of these seams are subject to dislocations, some of them small in extent and others of enormous amount; as also to denudation, which has swept away the coal from wide tracts of country, and especially in the vallies of the Tyne, the Wear, and the Tees. Unless the knowledge of these various phenomena are carefully preserved, the decay and abandonment of the mines will prove, when it is too late, the fatal imprudence of neglecting so obvious a department of national policy.

These observations might be extended to great length, were I to enter in detail upon the various and extensive considerations which present themselves on a review of the preceding statements, or refer to the numerous cases which might be adduced as illustrations of the present as well as of prospective evils. It is unnecessary to attempt to demonstrate, that upon authentic statistical data only, can any sound policy be based; yet in mining matters we are wholly without statistics. In this respect the continental states excel us as much as we excel them in the energy and skill with which English mining operations are conducted. Much mineral wealth will be wholly lost unless records are kept showing its position, as ascertained by the present and former ex-

plorations of it, and, in the emphatic words of Mr. Buddle, "GREAT LOSS OF LIFE AND DESTRUCTION OF PROPERTY WILL INEVITABLY ENSUE." In other mining districts it is quite apparent, on the most cursory examination of the subject, that a record of the position and state of coal seams and mineral veins is of the highest importance to all parties concerned. These observations have been collected with the view of calling attention to a bill which has been presented to the House of Commons, and read a first time, and which it is trusted will meet with the attention which the subject merits. It is at all events likely to attract the notice of all parties interested in mines, and to elicit from them such views and opinions as may be useful in guiding the legislature to a correct judgment on this important question of national statistics.

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